An SQL Database for ECG, Microbiology and Lab within an Integrated Patient Repository

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Abstract

The LASTWORD hospital system implementation at a large academic medical center supports an SQL database for microbiology, ECG and general laboratory results. This integrated system receives data from departmental computer systems in the form of HL7 messages and stores them in a long term database. The data structure relies heavily on phrase dictionaries which permit assignment of attributes and taxonomic or semantic interrelationships of terms.

Microbiology and ECG data are stored in two formats: as formatted text (literally as sent by the ECG and microbiology systems), and also as encoded data. This encoding is informal and imitative: the contents of this dictionary are driven entirely by the coded phrases employed by the respective systems which send results, and have no required formal structure. Thus, phrases may be any word or combination of words. In many cases, these are in fact useful conventional diagnostic phrases like organism names or ECG abnormalities, but could as easily be "no growth for 37 days" or "left upper". Each diagnostic dictionary table row has associated attributes (columns) which permit formalizing characteristics: e.g. genus, family, gram stain, morphology, aerobic, pathogenicity, positive vs. negative. Moreover, rows can be references to other rows in the same or another table, to imply a taxonomic or semantic relationship. These attributes and interrelationships can be created ad hoc, and can be used to classify and to restrict searches in database retrievals.

The elements of design which support the applications, are:

1. *Dictionary tables: Provide consistency, "knowledge"; minimize storage use.*
2. *Clinical data tables: Provide specific structure for storage of test results, topographic and diagnostic descriptions, and susceptibilities.*
3. *General patient tables: Provide demographic, registration, user information, etc. to be linked for complex data searches.*
4. *Text tables: Provide storage for text of comments, ECG and microbiology for rapid clinical reporting.*
5. *Query language: Provides tools for convenient retrieval and formatting of data.*
6. *LIS (Sunquest, Antrim, Marquette): Provides standard, convenient data entry.*
7. *HL7 Interface: Provides all data for both textual and encoded compact storage.*

The database permits ad hoc queries, which retrieve any of the clinical or demographic data within the system. Two features of the design enhance the power of the queries: the dictionary "attributes" and the (redundant) storage of text and encoded phrases. The presence of an attribute (e.g. "positive" for an organism) makes possible a search by this criterion, even if "positive" is not part of the result as received from the Lab system. The storage of the formatted text of ECG and microbiology results and the blood culture result makes their display in a query more manageable and legible than if only text phrases were stored, while the coded text provides consistent and convenient search criteria.

Clearly, the conceptual clarity of the relational model and the logical completeness of the attendant query language are its great strengths. Moreover, since the major efforts in database technology are currently being focussed on improving the performance and capacities of the relational model, it is becoming a de facto standard.

There are other distinct advantages to SQL. In the Tandem implementation, columns may be added as needed without the need to reconstruct the database explicitly. This is of great value in adding attributes to the Diagnostic Phrase dictionary. Keys may be likewise added to improve search efficiency, as retrievals initially too slow or unanticipated are added to the application. Still, the biggest advantage of SQL is universality. Both within the particular institution here, and across a customer base, the role of integrator will propel a commercial system towards the most "standard" tool, which is SQL.

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